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Application of fractional-moments statistics to data for two-phase dielectric mixtures

Nigmatullin R., Osokin S., Nelson S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

A new method for quantitative "reading" of dielectric data of two-phase dielectric mixtures is suggested. This method is based on ideas related to the application of the generalized mean value (GMV) function to random data series (statistics of fractional moments). The GMV function allows transformation of arbitrary random data series to smooth curves that in turn can be fitted by an analytical function with a limited number of parameters. These fitting parameters are sensitive to the influence of an external factor, so the dependence of these parameters on the external factor can be used as calibration curves. In this instance we analyzed dielectric data measured for ground hard red winter wheat with 12.5%, 17.9% and 21.2% moisture contents in the temperature range from 2°C to 76°C. This system is a complex system from the viewpoint of the complexity of the dielectric data interpretation. The common treatment of these dielectric spectra does not provide a monotonic calibration curve. We treated these spectra as random data series by the use of the GMV function. As a result of this treatment, we obtained the monotonic temperature dependence of several fitting parameters for the given moisture contents, and these relationships can be fitted by an analytical function for calibration use. We hope that this new method will find application for analysis of other complex systems. © 2008 IEEE.

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Keywords

Calibration curve, Dielectric properties, Dielectric spectroscopy, Generalized mean value, Hard red winter wheat, Permittivity, Random series, Statistics of fractional moments